Early Components of Word Reading: A High-Density ERP Study of Lexical Access

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Introduction

There is some debate as to whether a lexical decision task involves complete lexical semantic access. The reading of highly familiar words is automatic, yet does it necessarily involve full semantic access?

Our Goal: To examine early ERP components during lexical decision in two tasks involving the same words, one of which has a very simple semantic requirement as well.

Study 1

Method

Participants: 14 adults (11 females, Mean age = 24)
Stimuli and Tasks: 100 words and 100 4-5 letter pseudowords (e.g., blup) presented singly in two tasks (Figure 1).

Lexical Decision Task (LDT) → 5 blocks of 20 stimuli (10 words comprising 5 noun categories with 2 words each & 10 pseudowords) presented randomly. Participants made a word/non-word judgement as quickly and as accurately as possible.

Lexical Semantic Task (LST) → 5 blocks of 20 stimuli requiring a word/nonword judgement. In contrast to the LDT, words used in one block of LST belonged to one category (e.g., animal), and at the end of each block, participants were required to select a word (e.g. zebra) that fit with the category.

Stimuli, response-hand mapping and task order were counterbalanced (Figure 2.)

Electrophysiological Recordings:
-128-Channel EGI System, converted to 81 standard sites in BESA
- 500 Hz sampling rate, offline filtered 1 to 30 Hz. Impedances < 50 kΩ
- Epoch = 200 ms prestimulus, 800 poststimulus

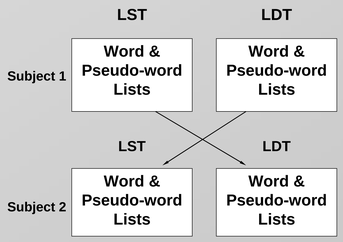

Figure 2

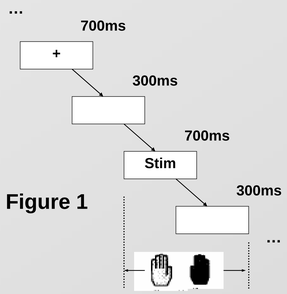

Figure 1

Results

Using LORETA's bootstrapping technique, electrode-wise comparisons were made every 2 ms
- Differences across tasks:
  - words: around 150 and 600 ms
  - pseudowords: 150, 250-350 and 600 ms
- 150 ms component: Topographically left inferior posterior region (near P9, Figure 4).
- 150 ms difference generator (using LORETA) within posterior left visual cortex (Figure 5).

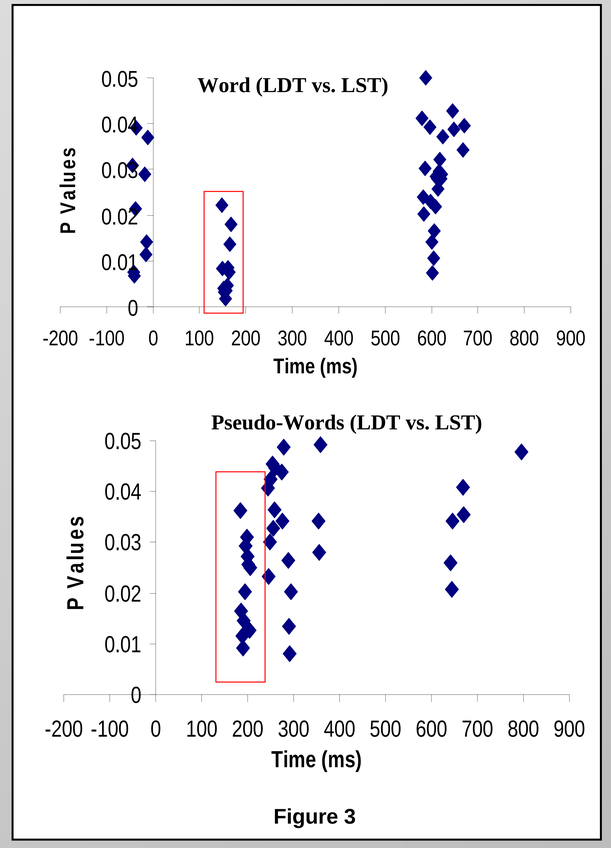

Figure 3

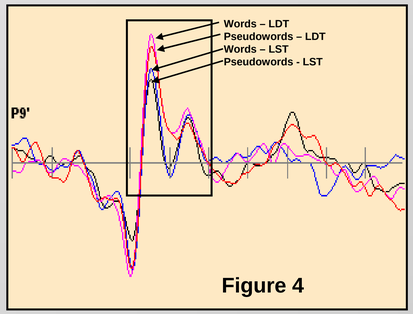

Figure 4

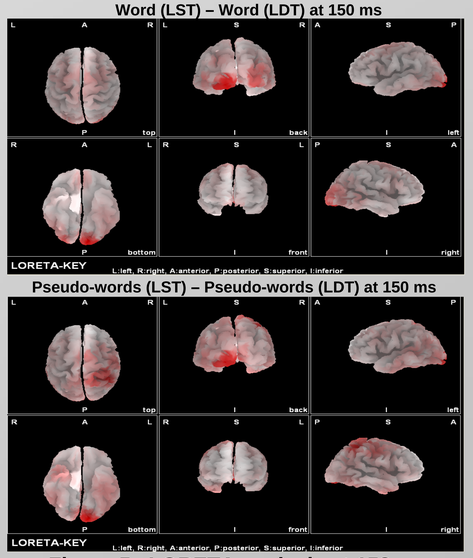

Figure 5. LORETA analysis at 158 ms.

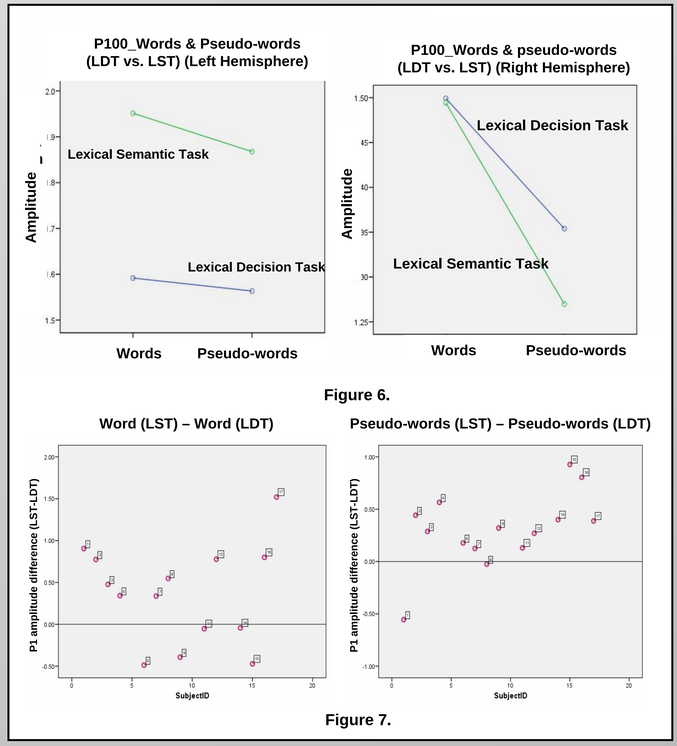

Figure 6.

Figure 7.

LST vs LDT tasks: early ERP component effect for both words and pseudo-words. Figure 7 shows individual data. Word vs PseudoWord: Greater P1 amplitude for words [F (1, 13) =4.7, p = .077], more so in RH [F (1, 13) = 6.1, p = .029], although interaction was not significant.

Study 2

Method

Purpose: To repeat Study 1 with words and pseudowords matched for length.
Participants: 14 adults (12 females, Mean age = 20)
Stimuli and Tasks: Same procedures as study 1 except that word and pseudoword lengths matched.

Results

LDT/LST x words/pseudo-words x LH/RH ANOVA on early ERP components P1 (average amplitude 80–120 ms) averaged for clusters of 5 sites around inferior posterior regions.
P1:larger amplitude in LST than in LDT [F (1,13) = 8.1, p = .014] due to LH effect [interaction (F (1,13) = 7.3, p = .018): Left F (1, 13) = 15.8, p = .002; Right n.s.] (Figure 6).

Conclusions

(1) **Word reading can be influenced by mild semantic task demands more quickly than traditionally thought (150 ms in study 1 and even earlier in study 2) .**
(2) Since those time windows are usually associated with sensory processing, our results suggest that the sensory/perceptual stage of word reading could also be influenced by a top-down semantic context factor.

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